

# NASA Glenn Safety Manual

## CHAPTER 9 - LOCKOUT/TAGOUT

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### 9.1 SCOPE

This chapter sets forth the minimum standards required by the Occupational Safety and Health Administration (OSHA) as given in 29 CFR 1910.147, "Control of Hazardous Energy (Lockout/Tagout)." It applies to both Government and contractor personnel as a means of controlling exposures to potentially hazardous energy sources during work operations at the NASA Glenn Cleveland Center and Plum Brook Station. It imposes basic rules to be followed to ensure protection against harmful exposures, and it presents the requirements for lockout/tagout. Exceptions to these safety standards must be authorized by the cognizant Safety Committee and reviewed by the GSO.

These standards do not apply to operations known as "hot tapping." These shall be dealt with on an individual basis by the appropriate Safety Committee and the GSO.

The procedures set forth in this chapter apply, during all work activities, to the control of potentially hazardous energy sources at any energy level capable of causing injury to personnel, damage to equipment, harm to the environment, and loss or compromise of test data. Energy sources and work activities include, but are not limited to, the following:

Energy sources	Work activities
Acoustical systems	Construction
Vacuum systems	Maintenance
Electrical systems	Installation
Pneumatic systems	Calibration
Hydraulic systems	Adjustment
Mechanical systems	Inspection
Compressed gas	Cleaning
Spring tension/compression	Repair
Suspended or moving loads	Close contact
Chemicals/fuels	
Cryogens	
Ionizing/non-ionizing radiation (e.g., lasers)	
Thermal systems (i.e., heat/cold)	

## 9.2 DEFINITIONS

- a. Affected employee: An employee whose job requires him/her to operate a machine or equipment on which servicing or maintenance is being performed under lockout/tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.
- b. Area Supervisor (AS): An employee who is responsible for the operation of equipment and personnel in a given area.
- c. Authorized Employee Representative (AER): Person responsible for all individuals within his/her organization working on a specific job or task. Prior to releasing the lockout, the AER will verify and assure that all individuals working under his/her lockout have completed their work, are accounted for, and will insure that all employees are clear, all tools removed and all guards reinstalled.
- d. Capable of being locked out: Equipped with an energy-isolating device that is designed with a hasp or other attachment or integral part to which, or through which, a lock can be affixed, or that has a locking mechanism built into it. Also includes other devices if lockout can be achieved without the need to dismantle, rebuild, or replace the device.
- e. Central Process Systems: Services, facilities, equipment, and components, managed, operated and maintained by the Facilities and Test Engineering Division, which directly support research facilities. These facilities include any system, equipment or component used for generating, supplying, conveying, distributing, conditioning, monitoring, measuring, removing or processing of air, exhaust, lubricating oil, control oil, pneumatic controls, refrigerants, cooling tower water, natural gas and the entire high voltage electrical power distribution system. The end point of these systems, relative to test cells is generally recognized as the Central Process Systems isolation valve(s) serving a particular facility. The electrical power dispatcher (EPD) and the central air dispatcher (CAD) must be involved in all lockout/tagout procedures involving the Central Process Systems.
- f. Energized: Connected to an energy source or containing residual or stored energy.
- g. Final Point of Isolation. The selected energy isolating device closest to the work being performed.
- h. Energy isolating device: A mechanical device that physically prevents the transmission or release of potentially harmful energy, for example, a disconnect switch, a blind flange, or a physical block preventing motion of a mechanical device or valve. (Control components such as push buttons and operating levers that are used in normal operation to direct energy flow or release do not qualify as energy-isolating devices.) Selection criteria are found in Sec. 9.8.
- i. Energy source: A source of potentially harmful electrical, thermal, pneumatic, mechanical, hydraulic, chemical, or other energy (See Sec. 9.1.).
- j. High Voltage Electrical System: Equipment, parts and components used in distributing electrical power to all institutional and research loads throughout the Glenn Research Center, at a voltage level of 600 volts or greater. This system is considered to be part of the Central Process Systems.
- k. Hot tap: A procedure used in repair, maintenance, and service activities in which a piece of equipment (pipeline, vessel, or tank) is welded on under pressure in order to install

connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, and steam distribution systems.

- l. Lockbox: Container for keys to be used for multiple AER tasks. Lockboxes must accommodate multiple hasps, and the requestor having control over the lockbox must place them at well-recognized, accessible locations. Hasps may be used instead of a lockbox if same level of control can be achieved.
- m. Lockout: A procedure whereby one or more lockout device(s) is placed on an energy-isolating device(s) to ensure that neither the energy-isolating device nor the equipment being controlled can be operated until the lockout device is removed.
- n. Lockout device: A device that utilizes a positive means (such as a keyed lock) to hold an energy-isolating device in the safe position, thereby preventing the energizing of a machine or equipment.
- o. Multiple AER lockout: Procedure used when a device needs to be locked out by 2 or more AER's.
- p. Multiple lockout device: A mechanical device, such as a hasp, enabling application of more than one lock to an energy-isolating device.
- q. Normal operation: The utilization of a machine or equipment to perform its intended function.
- r. Positive means of protection: Prevention of potentially harmful release of energy by a means that would require unusual and obvious measures to defeat.
- s. Requestor: The person responsible for coordinating all LO/TO activities for a given task. Activities include completing the planning form, maintaining all documentation in the field, coordinating device selection and isolation, and control of the lockbox when used. All requestors shall be trained per Sec. 9.6.
- t. Servicing and/or maintenance: Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include any situation where the employee may be exposed to the unexpected energization or startup of equipment or release of hazardous energy.
- u. Single AER Lockout: Method of securing energy isolating device(s) to provide positive means of protection against potentially harmful energy release.
- v. Switching Orders: Written or verbal, step-by-step procedures developed by Electrical Dispatchers, and utilized in the process of switching in, or switching out, high voltage electrical loads through the high voltage electrical power distribution system. These procedures specify an exact sequence of steps to be taken by qualified, authorized personnel (Switchperson) that are responsible for performing isolation, lockout and tagout of equipment, systems and components throughout the high voltage electrical power system.
- w. Switchperson: Personnel, determined by NASA to be qualified and authorized to perform electrical and/or mechanical switching activities in order to implement LO/TO.
- x. Tagout: Affixing a yellow lockout tag (NASA Form C 946, Rev. 5 95) on an energy-isolating device, to indicate that the energy-isolating device and the equipment being controlled may not be operated until the tag is removed.

## 9.3 GENERAL REQUIREMENTS AND RESPONSIBILITIES

These basic requirements underlie the formulation of the safety standards outlined in this chapter and guide their implementation:

- a. If equipment is "capable of being locked out," potentially hazardous energy sources must be (1) identified, (2) be locked out, (3) tagged, (4) de-energized, and (5) verified safe during periods of activity/operation when exposures to those sources could cause harm.
- b. If equipment is not "capable of being locked out," alternative protective measures must be employed. These alternative measures must include tagout, and must provide a level of safety equivalent to that obtained by using a lockout procedure. Examples of alternate measures include: pulling fuses; installing blocks; and installing grounds.
- c. Locks intended for use under the requirements of this chapter must not be used for any other purposes.
- d. A yellow lockout tag, NASA Form C-946 (Rev. 5-95), must be used in conjunction with each positive means of protection. Although other tags may be used for other purposes, only yellow lockout tags shall be used for lockout procedures.
- e. Operating any device in violation of a lock or a yellow lockout tag is prohibited.
- f. All newly acquired equipment involving potentially hazardous energy sources must be outfitted to accommodate lockout devices per 29 CFR 1910.147 (c)(2)(iii). Also included is any equipment which is replaced, renovated, or has major repairs conducted on it. In each of these instances, the equipment must be retrofitted to accommodate lockout devices per 29 CFR 1910.147 (c)(2)(iii).
- g. Supervisors of NASA and contractor personnel must ensure that employees under their supervision who are affected by or will use lockout/tagout procedures are trained to do so and are trained to recognize potentially hazardous energy sources, per Sec. 9.6.
- h. Violating any lockout/tagout rule or procedure shall result in disciplinary action.
- i. Supervisors of NASA and contractor personnel must ensure that employees under their supervision comply with the requirements of this chapter and with the applicable lockout/tagout procedures.
- j. All Requestors must be thoroughly knowledgeable of when their work assignment involves any Central Process Systems equipment. If unsure, the Requestor shall call the Air Dispatcher at 3-3200 for clarification.
- k. The requestor shall be aware of the type and magnitude of the energy that the equipment utilizes and shall understand the hazards thereof.
- l. A switchperson shall place isolation grounds where required. Personal protective grounds shall be placed (where required) by the requestor and are considered energy isolating devices. The Electrical Dispatcher shall be notified, and shall authorize such ground placement. The Electrical Dispatcher shall record ALL grounds that have been placed. (See Sec. 9.8 for guidelines on using grounds as devices.)

- m. When the work performed under LO/TO has been completed, the AER shall check the area around the equipment or process to ensure that all tools have been removed, all guards have been reinstalled, and all employees are in the clear. They must ascertain that everyone connected with the work on the system is accounted for before the locks and tags are cancelled.

## **9.4 SPECIFIC PROCEDURES**

Procedures for lockout/tagout are divided into two categories, single AER and lockbox lockouts. Single AER procedures are typically used when one organization is performing work. Multiple AER procedures are used when more than one organization is performing work.

### **9.4.1 Single AER Lockout (Requestor is the AER)**

- a. Pre-Planning: (see appendix for details on pre-planning and completing the planning form)
  - The Area Supervisor (AS) (and EPD/CAD for Central Process Systems) is notified of the need for a LO/TO.
  - A requestor is identified for a specific task by joint consensus by all parties/organizations involved in the task.
  - A planning form (NASA Form C-3050) is completed by the requestor.
- b. The requestor fills out the yellow lockout tags.
- c. A Switchperson is directed to begin switching, and hanging tags as supplied by the requestor.
- d. System/device is de-energized.
- e. Requestor hangs lock on final isolation point, verifies isolation and then notifies AS (and EPD/CAD for CPS).
- f. Work is performed.
- g. Tag and Lock Removal
  - Requestor verifies that the task is complete.
  - Requestor notifies AS (and EPD/CAD for CPS) that the task is complete, and the tag is cancelled.
  - Requestor removes locks from final isolation points.
  - The AS (and EPD/CAD for CPS) directs a switchperson to return devices to normal operation.
  - The switchperson and requestor notifies AS (and EPD/CAD) that switching has been completed.
  - All tags are returned to the requestor.

### **9.4.2 Multiple AER Lockout**

- a. Pre-planning: (see appendix for details on pre-planning and completing the planning form)
  - The Area Supervisor (AS) (and the EPD/CAD for Central Process Systems) is notified of the need for a LO/TO.

- A requestor is identified for a specific task by joint consensus by all parties/organizations involved in the task.
  - A planning form (NASA Form C-3050) is completed by the requestor.
- b. The requestor fills out the yellow lockout tags.
- c. Hanging of tag and locks
  - A Switchperson is directed to begin switching, and hanging tags as supplies by the requestor.
  - Systems/devices are de-energized and verified safe.
  - Requestor hangs locks on final points of isolation.
  - Requestor places all keys in lockbox, and places a lock and yellow lockout tag on the box with a hasp (if necessary) to accommodate all AER locks, and notifies AS (and EPD/CAD for CPS).
  - AER's are notified that isolation is complete, place locks with AER's name on the lockbox, and verifies isolation.
- d. The work is performed.
- e. Lockbox Tag and Lock Removal by AER's
  - AER's will verify and insure that their task is completed.
  - AER's notify requestor and area supervisor that the task is complete prior to removing their locks and tags from the lockbox. Once removed, the tags are returned to the requestor.
- f. Device Tags and Locks removal
  - Requestor verifies all AER tags are removed from the lockbox and that the task is completed.
  - Requestor notifies AS (and EPD/CAD) that task is complete and requests lock and tag removal.
  - Requestor removes yellow lockout tags and locks from all final points of isolation.
  - The AS (and EPD/CAD) directs a switchperson to return devices to normal operation.
  - The switchperson returns tags to the requestor.
  - The switchperson notifies AS (and EPD/CAD) that switching has been completed.

### **9.4.3 Emergency Lock Removal**

When the AER/Requestor is unavailable to remove his or her lock/tag, that device may be removed by following these procedures:

- a. The AER/Requestor's supervisor is notified.
- b. The AER/Requestor's supervisor verifies that the AER/Requestor is not available to remove his or her lock/tag (every possible effort to locate the AER/Requestor shall be made prior to lock/tag removal).
- c. The AER/Requestor's supervisor advises the Area Supervisor of the emergency removal.

- d. The AER/Requestor's supervisor assumes the responsibility of the AER/Requestor and removes the lock/tag, if safe to do so.
- e. All affected employees shall be notified by AER/Requestor's supervisor of the removal of the lock as soon as possible or at least prior to returning to the job.
- f. Notification to the AER/Requestor's line management and GSO documenting the action, shall then be made by the AER/Requestor's supervisor.

## **9.5 INSPECTIONS OR AUDITS**

Inspections or audits of conformance to the standards of this chapter must be conducted at least annually by the GSO. The purposes of inspections/audits are to gauge the effectiveness of these standards and to guide their revision, thus ensuring their continued effectiveness. Results of inspections or audits are to be documented per OSHA 29 CFR 1910.147 (c)(6)(ii), submitted to the responsible organization, and kept on file in the GSO.

## **9.6 TRAINING**

Training in the requirements of these safety standards must meet the requirements of 29 CFR 1910.147 (c)(7). Line management will provide such training to Area Supervisors/managers, Requestors, area employees, safety committee members, and all other affected employees.

The training must provide instruction in:

- a. Recognition of potentially hazardous energy sources.
- b. The purposes and functions of controlling potentially hazardous energy sources, as required by this chapter.
- c. Regulations prohibiting any attempt to restart or re-energize machines or equipment that have been locked/tagged out.
- d. Skills for applying energy-isolating devices, and procedures for lockout/tagout.
- e. The limitations associated with tagout procedures per 29 CFR 1910.147 (c)(7)(ii).

Retraining/refresher training shall reaffirm employee proficiency and introduce new or revised control methods and procedures as necessary. Retraining will be required at least every 4 years and also when:

- a. Changes in job assignment bring about changes in the types of potentially hazardous energy sources to which the employee might be exposed.
- b. Changes in equipment or acquisition of new equipment bring about changes in the types of potentially hazardous energy sources to which the employee might be exposed.
- c. Changes occur in energy control procedures.
- d. Results of inspections/audits indicate training inadequacies.
- e. These safety standards are revised in any substantive way.

Results of training (i.e., attendees, topics covered, dates) are to be documented and filed with the Technical and Administrative Training Office.

## **9.7 APPENDIX A - PLANNING AND FORM COMPLETION INSTRUCTIONS**

The following planning sequence is followed for both Single and Multiple AER Lockouts.

- a. The requestor, working with personnel knowledgeable of the system defines the isolation devices involved in the lockout.
- b. The requestor obtains a list of all devices to be locked out. See Appendix B.
- c. The requestor shall obtain concurrence from the AS and EPD/CAD to isolate, tagout and lockout the equipment. This approval shall be the issuance of a CENTRAL CONTROL DISPATCH TAG # by the EPD/CAD when Central Process System devices are involved.
- d. Each AER involved reviews and concurs with the devices selected (for Multiple AER lockout only).
- e. A copy of the planning form is given to the AS (and EPD/CAD) when CPSs are involved), and all AER's.
- f. The planning form is not required when only one AER is involved and the task to be performed is simple in nature (i.e., few devices, short in duration, under direct control of AER)

## **9.8 APPENDIX B - DEVICE SELECTION RESPONSIBILITIES AND CRITERIA**

### **9.8.1 Device Selection Responsibilities**

It is important that the responsibilities for critical decisions be clearly defined when planning lockout/tagout. The following is offered to clarify who is responsible for device selection.

- a. For Equipment Isolation - The area supervisor will identify all devices that are needed to safely isolate equipment that is in his/her area of responsibility. The area supervisor will use the device selection criteria that is outlined in 9.8.2 of this appendix to do so.
- b. For Central Process Distribution System Isolation, (1) EPD or CAD will assume the function of the area supervisor for the distribution system. This includes matters relative to distribution equipment modification or when facility isolation is necessary (single or multiple). (2) EPD will be responsible for defining all electrical isolation devices associated with the GRC power distribution system. CAD will be responsible for defining all valves necessary to safely isolate the air distribution system.

- c. System Boundaries - The following devices are used to assist in defining boundaries within the Central Process System. When a device is needed for isolation and is outside the area supervisor's responsible area then the adjoining area supervisor will be responsible for clearly identifying the appropriate device.

The following are general guidelines to be used when specific guidelines are not available:

- The boundary between the electrical power distribution system and an area is the first device out of the substation.
- The boundary between the air service generation equipment and the distribution system is the first valve outside the generating building.
- The boundary between the distribution system and the utilization equipment is the cell isolation valve.

### **9.8.2 Device Selection Criteria**

Isolation - Devices necessary to make machine (system) safe to work on.

Breaks required for Mechanical Systems - One valve isolation to be used when working on the system. Two valve isolation to be used when working within the system. A valve, blind flange, open disconnect, and blocking or bracing of an open valve device is considered a break.

Isolation of Electrical Systems - For High Voltage Isolation (over 600 volts) two breaks and a break between any potential transformers and work area are required. For Low Voltage Systems (under 600 volts) only one break is required. The following constitutes a break: a ground placed on the load side of isolation device; open circuit breaker; lowering circuit breaker from its operating position; or removing conductors from the device.

## **9.9 BIBLIOGRAPHY**

- Title 29, Code of Federal Regulations, Part 1910, Sec. 147. Occupational Safety and Health Standards. The Control of Hazardous Energy (Lockout/Tagout).

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